Carbon Cycle Greenhouse Gases Group

The Carbon Cycle Greenhouse Gases group of the Global Monitoring Division takes consistent measurements at clean air sites every day and supplements these with a network of weekly air samples collected all over the world, consisting of the largest network and most accurate measurements of this kind. The clean-air baseline observatories are located in very remote places, to limit the amount of urban pollution being collected. NOAA's observatories are located at the South Pole; Barrow, Alaska; American Samoa; Mauna Loa, Hawaii; Summit Station in Greenland, and Trinidad Head, California. NOAA began managing operations at the first four sites when NOAA was formed in 1970; however, the atmospheric observations at the South Pole and Mauna Loa began in 1957-1958 during the International Geophysical Year.

Dots on the map indicate locations where volunteers collect air samples at designated sampling sites. The volunteers are trained and provided with a calibrated suitcase-like device (like the one shown on the tour) called a Portable Sampling Unit, along with two glass flasks per week. Glass is used to collect and transport the air samples as it does not react with the six trace gases measured: carbon dioxide (CO2), carbon monoxide (CO), Sulfur Hexafluoride (SH6), methane (CH4), molecular hydrogen (H2), and Nitrous Oxide (N2O).

Two flasks are sampled each time (on-the-fly quality control) once a week at each site and mailed back to NOAA Boulder via courier services and U.S. embassies. About 16,000 flasks are processed in the flask lab per year, using gas chromatographs and other instruments for measuring concentrations as small as parts per trillion. When

daily calibration standards are counted, over 20,000 samples are measured each year.

Vertical representations of the atmosphere are also collected using aircraft, which take samples in increments as they leave ground and ascend to lower pressures (altitude: 20,000 ft); these airplane samples are represented by the yellow dots with planes in them.

Global Monitoring Division also monitors samples from a network of tall towers, denoted by the green dots, which collect daily air samples similar to the baseline observatories at altitudes of 100, 300, 500 and 1000 feet high. A map showing the entire sampling network is available online. Clicking a colored dot enables the user to see the measurement values at each site.

The dynamic graph presented here tells the story of carbon dioxide concentrations in the atmosphere. The pump handle graph shows the seasonal variability measured against surface latitude since 1979. You can see a much larger seasonal variation in the Northern Hemisphere. The majority of the world's forests and cities are located in the Northern Hemisphere, whereas the Southern Hemisphere consists of mostly oceans and ice. Therefore, the majority of the sampling takes place in the Northern Hemisphere. If you notice the graph of CO2 concentrations from the baseline observatories you'll notice that the Earth has a natural breathing cycle; the terrestrial biosphere takes up CO2 for making woody plant material in the spring and summer months during photosynthesis then releases the CO2 back into the atmosphere as the leaves and green material decays in the colder fall and winter months during respiration.

The graph also shows the Keeling Curve (carbon dioxide measurements at Mauna Loa, Hawaii, since 1956) and a number of ice core records spanning 800,000 years of carbon dioxide cycles indirectly measured in fossil air pockets found in ice on Greenland and Antarctica.